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# HABITAT SELECTION OF LEWIS' WOODPECKERS IN SOUTHEASTERN COLORADO

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ABSTRACT.—Lewis' Woodpeckers (*Melanerpes lewis*) on the plains in the Arkansas River valley and in the foothills of the Wet Mountains in southeastern Colorado used large, dead or decaying broadleaf cottonwoods (*Populus deltoides*) for breeding and for winter mast storage. On the plains, they nested near fallow and mowed fields, but avoided anthropogenic structures and grazed fields. During the 1992–1993 winter, woodpeckers occupied sites near corn fields, and stayed on these sites into the 1993 breeding season. In the foothills, they avoided dense stands of trees at all times of year, nested near grazed fields, and wintered near oaks. Riparian habitats were particularly important to Lewis' Woodpeckers in southeastern Colorado, especially those with large mature cottonwoods. *Received October 26, 1995, accepted 1 Sept. 1996.*

Lewis' Woodpeckers (*Melanerpes lewis*) were placed on the Audubon Society's Blue List for 1975 (Arbib 1974), and local population declines have been recorded in Utah and in British Columbia (Behle et al. 1985, Sorenson 1986, C. Siddle, pers. comm.). Atypical of most picids, these birds flycatch during the breeding season and store mast in the winter (Bock 1970). Although others have described their breeding and winter habitats (Bent 1939, Bock 1970, Hadow 1973, Sousa 1982), no studies have quantified specific attributes of occupied versus random sites for this bird during either the breeding or winter season. The objective of the present study was to determine the habitat requirements for this species during the breeding and winter seasons in southeastern Colorado by comparing occupied site characteristics with random site characteristics. The specific aims of the project were (1) to quantify nest tree, nest cavity, and storage tree characteristics and compare these to random tree characteristics, (2) to characterize the breeding season habitats surrounding nest trees and random trees, and (3) to characterize the winter habitat surrounding storage trees and random sites, with an examination on the effect of mast on the winter site selection.

## METHODS

I studied woodpeckers in 1992–1993 at two riparian woodland sites in southeastern Colorado. One site was on the plains of the Arkansas River Valley (38°05′N, 103°45′W, 15 km from Rocky Ford, elev. 1285m) and was intensively farmed and/or grazed. The second was in the foothills of the Wet Mountains (38°05′N, 104°58′W, 15 km from Beulah, elev. 1939 m) and supported moderate livestock grazing. During the breeding seasons, I measured 30

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nest trees on the plains and 17 in the foothills. During the winter, I measured 21 storage trees on the plains and 13 storage trees in the foothills.

I compared attributes of occupied sites with characteristics of random sites to determine whether habitat selection occurred. Occupied trees during the breeding season contained at least one nesting Lewis' Woodpecker pair, while occupied trees during the winter contained mast stores from at least one bird. Multiple Lewis' Woodpecker pairs occasionally nested in the same tree, and in these instances, the tree was used as the sample unit. Although some nest trees in 1992 were also used by the birds in 1993, these trees were excluded from the analysis. Random sites were selected by placing a pencil at spots on a 1:24000 United States Geological Survey topographic map, and by choosing the tree closest to the marked spot on the map. If a grove of trees was on the spot on the map, a tree was selected within the grove.

Tree characteristics such as the diameter at breast height (dbh), height, species, and health (live vs dead or decaying) were noted for nest trees and storage trees. Measurements for dbh were taken with a measuring tape and nest cavity orientation was measured with a compass. Nest tree, storage tree, and nest cavity heights were determined using a Suunto clinometer. Several factors were used to determine the health of occupied trees. Broken limbs are probable entry sites for heartwood decay (Conner et al. 1976, Conner and Locke 1982, Daily 1993), and these were used as an indicator of decayed trees. Additional features used to identify decaying trees included the lack of bark and leaf growth on branches, as well as visual observations of decayed wood in exposed branches. By these criteria, dead and decaying trees were distinguished readily from healthy trees that lacked all signs of decay as noted above. Similar measurements were made at randomly selected trees and comparisons made to determine if tree selection was occurring.

I quantified habitats surrounding nest trees, storage trees, and random trees by bird-centered habitat analysis (hereafter BCA; Larson and Bock 1986). Each occupied tree/random tree served as the center of a circular plot; since birds almost always foraged within 100m of the nest/storage tree (pers. obs.), I chose this as the radius of the BCA plots. I divided each BCA plot into 16 sections and assigned a single habitat type to each section: fields (fallow, grazed, or mowed), trees, anthropogenic structures, and bare ground. Corn fields and cultivated fields were additional habitat variables recorded only at the plains sites. Since cultivated fields were plowed under in the fall on plains sites, plowed fields were substituted for cultivated fields in the winter analysis. Oaks were present only in the foothills and were assigned separately from the general tree category because of their importance as a mast source.

The habitat type assigned to each plot section represented its major land cover. Typically, a plot section consisted of only a single habitat type (e.g., grazed field). However, if mixed habitat types occurred in a plot section, I assigned the habitat type which represented >50% of the land cover in that section. The frequencies of habitat types were totaled for each BCA plot; graphically, these frequencies were used to generate the average percent habitat type per BCA plot.

The effects of mast on nonbreeding habitat selection were determined by examining the presence of mast sources in relation to occupied storage trees. Since corn was the only mast available to birds wintering on the plains, I compared the frequency of corn fields in occupied BCA plots with those in random plots. Winter food estimates in the foothills were based both on the presence of oaks within BCA plots and their corresponding acorn crops. I estimated acorn crops by placing a 0.5 $m^2$ hoop randomly on the ground beneath a randomly chosen oak and counting the number of acorns inside the hoop. Partially buried acorns and acorn caps were not counted in the analyses, as they may have been part of the previous year's crop. Three replicates were performed per quadrant in the four BCA quadrants surrounding both storage trees and randomly selected oak trees (N = 12 hoops per plot).

Because the data deviated from normality, I used the Mann-Whitney *U* test (Zar 1984) to compare dbh and tree height data. I used a chi-square contingency table to compare the species and health of nest trees versus random trees. I tested the null hypothesis that there was no significant difference in the nest cavity orientation among breeding pairs with the expectation of an equal number of nest holes in the north, south, east, and west quadrants. To determine if the surrounding habitats affected habitat selection, I compared the frequency of occurrence of different habitat types between occupied and random sites using a chi-square contingency statistic (Zar 1984). I used the method of Neu et al. (1974) to determine the habitat characteristics contributing significantly to the chi-square scores. Since foothills breeding data did not differ significantly between years, these data were pooled. Plains nest season data differed between 1992 and 1993 and are presented separately. In order to examine the effects of mast on habitat selection, I compared the frequency of corn fields between occupied and random sites using Neu et al. (1974). I used the Mann-Whitney *U* test to compare average number of acorns between occupied and random sites. All data are presented as averages and standard deviations unless otherwise indicated.

## RESULTS AND DISCUSSION

*Nest tree and storage tree characteristics.*—Forty-seven nest trees were measured over the two breeding seasons. Nest trees at both sites were taller than random trees (20.4 m ± 5.2 vs 12.5 m ± 6.4) ($U$ = 373.0, df = 1,46, $P < .0001$) and of larger diameter than random trees (112.6 cm ± 38.8 vs 63.6 cm ± 54.9) ($U$ = 444.0, df = 1,46, $P < .0001$). All nest trees (N = 47) were dead or decaying broadleaf cottonwoods (*Populus deltoides*) (Table 1). Nest holes (N = 59) averaged 11.1 m ± 3.4 in height (range = 5.3 m to 20.7 m), and hole orientation (N = 59) did not differ from random ($\chi^2$ = 1.6, df = 3, $P > .50$).

Dead or decaying nest trees are important habitat components for many breeding North American woodpeckers. For instance, most nests of the Pileated Woodpecker (*Dryocopus pileatus*) (Bull 1987) and Red-headed Woodpecker (*Melanerpes erythrocephalus*) (Reller 1972) were in dead trees, while Red-cockaded Woodpeckers (*Picoides borealis*) nested only in live pine trees which possessed decaying heartwood (Ligon 1986). The soft wood of dead/decayed trees is critical for Lewis' Woodpecker breeding activities because their skulls are not adapted to drilling into hard wood (Spring 1965).

I measured 34 storage trees during the 1992–1993 winter. Trees used for mast storage differed significantly from random trees at both sites. Storage trees were taller (17.5 m ± 6.7 vs 10.9 m ± 6.0) ($U$ = 240.5, df = 1,33, $P < .0002$) and of greater diameter than random trees (104.8 cm ± 34.8 vs 61.7 cm ± 89.2) ($U$ = 197.0, df = 1,33, $P < .0001$). Lewis' Woodpeckers also stored mast significantly more in dead/decaying broadleaf cottonwoods (Table 1).

Among those woodpeckers which store mast, many utilize storage trees

TABLE 1
HEALTH AND SPECIES OF OCCUPIED TREES AND RANDOM TREES DURING 1992–1993 IN SOUTHEASTERN COLORADO

| Season | Tree characteristics | Occupied trees | Random trees |
|---|---|---|---|
| Breeding | Health[a] | | |
| | Dead/decaying | 46 | 19 |
| | Alive | 1 | 28 |
| | Species[a] | | |
| | *Populus* sp. | 46 | 19 |
| | Other spp. | 1 | 28 |
| Winter | Health[a] | | |
| | Dead/decaying | 28 | 12 |
| | Alive | 6 | 22 |
| | Species[b] | | |
| | *Populus* sp. | 27 | 14 |
| | Other spp. | 7 | 20 |

[a] Characteristics differed significantly ($P < 0.001$) between occupied and random trees.
[b] Characteristics differed significantly ($P < 0.005$) between occupied and random trees.

with similar characteristics. Acorn Woodpeckers (*Melanerpes formicivorus*) constructed huge granaries in dead trees with deep bark (MacRoberts and MacRoberts 1976). Similar types of trees were used by Red-bellied Woodpeckers (*Melanerpes carolinus*) (Kilham 1963) and Red-headed Woodpeckers (Kilham 1958a, b, Moskovits 1978). While Acorn Woodpeckers drilled individual holes for the storage of each acorn, Red-headed Woodpeckers, Red-bellied Woodpeckers, and Lewis' Woodpeckers all tended to use natural cavities and crevices. For Lewis' Woodpeckers in Colorado, the deep furrowed bark of cottonwoods and the presence of crevices in decaying trees may have facilitated storage of acorns.

*Breeding habitat characteristics.*—Habitat characteristics surrounding nest trees in the foothills differed from habitat characteristics surrounding random trees ($\chi^2 = 38.4$, df = 6, $P < .001$) (Fig. 1). Lewis' Woodpeckers nested near grazed and mowed fields, and near oaks. Light or moderate grazing occurred at this site, and lightly grazed areas contain higher densities of grasshoppers (Capinera and Sechrist 1982, Jepson-Innes and Bock 1989, Welch et al. 1991) and other insects (Lavigne and Kumar 1972) than heavily grazed areas.

Bare ground, ungrazed grasslands, and structures were all habitat types that did not occur near occupied sites in the foothills. Presumably, few insects would be present on bare ground due to the lack of vegetation.

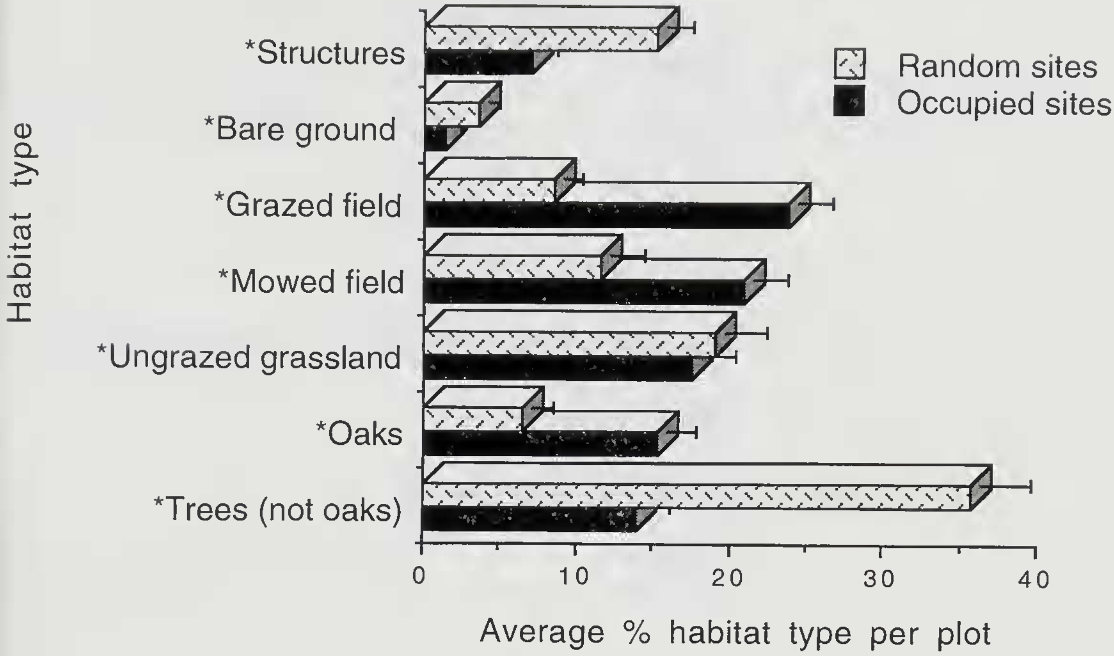


FIG. 1. Characteristics (mean percent habitat type per plot ± SD) of 100-m diameter plots surrounding 17 Lewis' Woodpecker nest trees vs 17 random trees during the 1992 and 1993 breeding seasons in the foothills of the Wet Mountains. Asterisks represent those habitat variables which differ significantly between occupied and random sites.

Although ungrazed fields can support high insect numbers (Lavigne and Kumar 1972), the height of the grass may have obscured insect visibility.

Lewis' Woodpeckers did not nest near dense tree stands, a trend noted in other studies (Bendire 1895, Bent 1939, Snow 1941, Bock 1970, Sousa 1982). Dense forest stands may impede flycatching maneuverability and, in addition, numbers and visibility of flying insects may be low. Nests did not occur near anthropogenic structures, possibly because Lewis' Woodpeckers are shy birds (Snow 1941, Bock 1970). Habitats surrounding nest sites on the plains differed from random sites ($\chi^2$ = 85.7, df = 7, $P < .001$) (Fig. 2), but patterns differed from those found in the foothills. While birds in the foothills nested near lightly grazed fields, heavily grazed fields on the plains were avoided, possibly because of low insect abundance (Lavigne and Kumar 1972). Nests occurred near fallow and mowed fields; fallow fields can support high insect numbers (Lavigne and Kumar 1972) and mowed fields may have increased insect visibility while still retaining enough plant biomass to support adequate insect populations.

In 1993, plains habitat characteristics again differed between occupied and random sites ($\chi^2$ = 85.7, df = 7, $P < .001$) (Fig. 3), but patterns were very different than in 1992. The birds avoided fallow fields, mowed fields, grazed fields, and areas with many trees. Nest sites occurred near

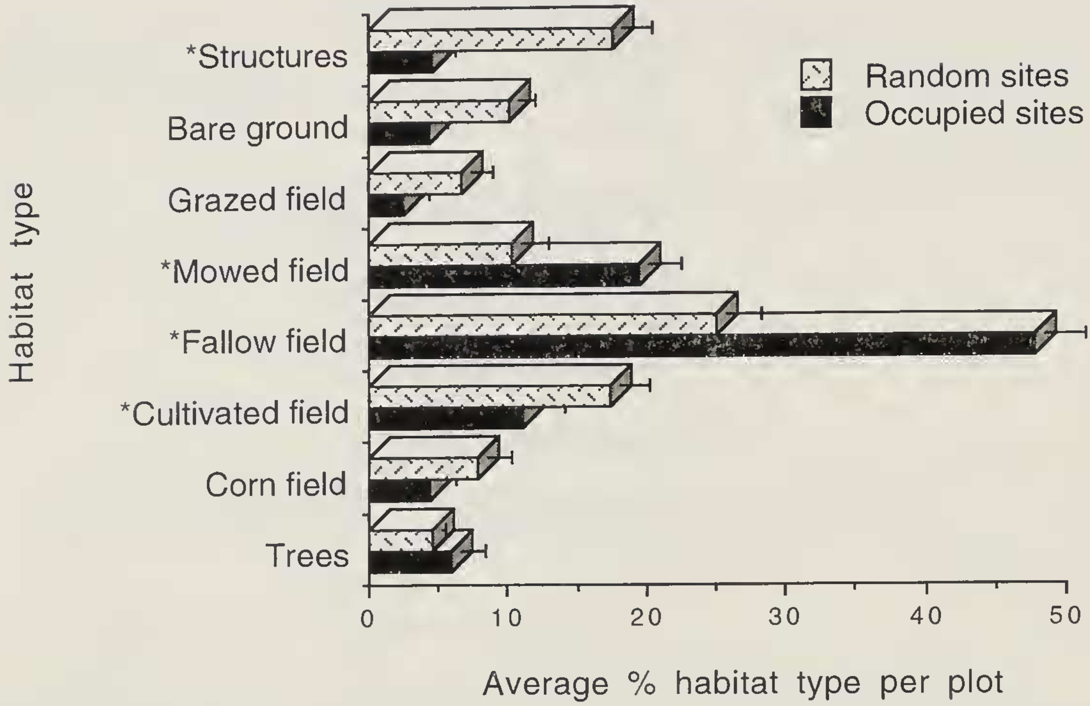


FIG. 2. Characteristics (mean percent habitat type per plot ± SD) of 100-m diameter plots surrounding 11 Lewis' Woodpecker nest trees vs 11 random trees during the 1992 breeding season on the plains of eastern Colorado. Asterisks represent those habitat variables which differ significantly between occupied and random sites.

cultivated fields, especially near corn fields. Corn fields did not occur near nest sites in 1992 but were common in 1993 breeding sites; this difference was due to many of the wintering birds remaining on their winter sites into the 1993 breeding season. Many of the birds breeding in 1992 may have also stayed on their 1991–1992 winter sites. However, by the beginning of the 1992 breeding season, many of the corn fields had been plowed and were fallow in the summer of 1992.

*Winter habitat characteristics and the effects of mast on winter site selection.*—Occupied winter sites in the foothills differed from random sites ($\chi^2 = 38.1$, df = 6, $P < .001$) (Fig. 4). While occupied winter sites did not occur near ungrazed fields, structures, or bare ground, they did occur near oaks. Acorn crops were higher at occupied sites than at random sites ($U = 1352$, df = 1,51, $P < .002$). An average of 28.3 ± 4.2 total acorns occurred within a 0.5 $m^2$ area at 13 occupied sites, and an average of 10.4 ± 3.1 total acorns occurred at 13 random sites. Acorns are the major source of food in the winter for this species in the foothills, and Lewis' Woodpeckers wintered near good sources of this mast.

While Lewis' Woodpeckers typically defend an individual storage tree containing their acorn stores (Bock 1970), some birds in the foothills shared storage trees. Specific parts of the trees were actively defended by

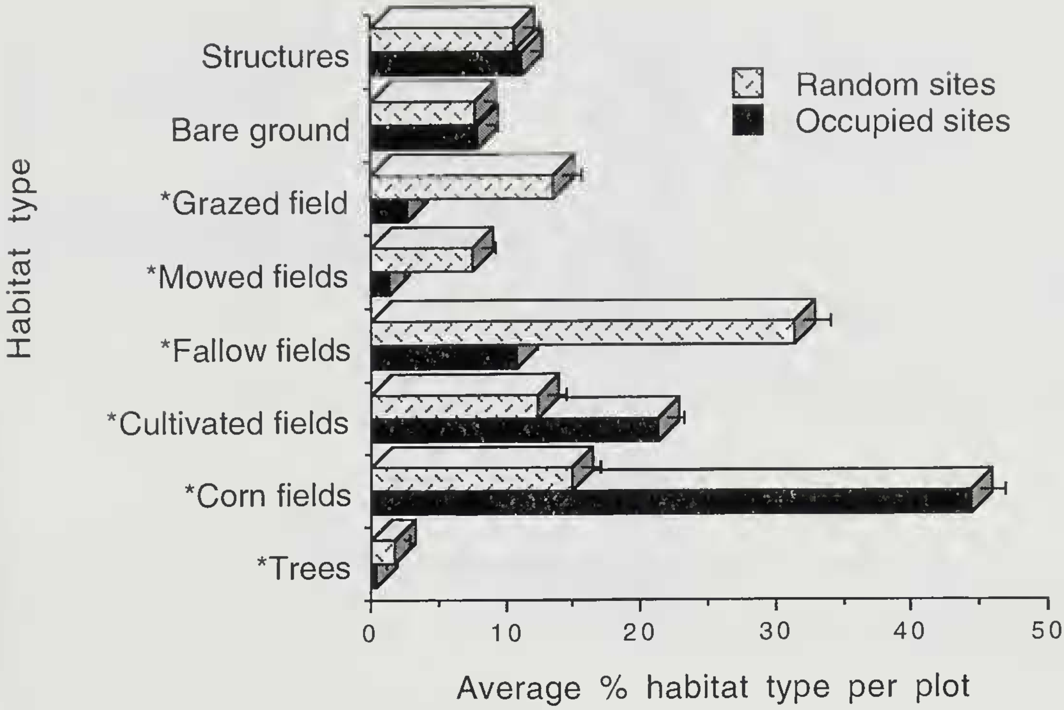


FIG. 3. Characteristics (mean percent habitat type per plot ± SD) of 100-m diameter plots surrounding 19 Lewis' Woodpecker nest trees vs 19 random trees during the 1993 breeding season on the plains of eastern Colorado. Asterisks represent those habitat variables which differ significantly between occupied and random sites.

the individuals storing acorns in that region of the tree. The sharing of storage trees in this region suggests that suitable storage trees may be a limiting resource during the winter.

Lewis' Woodpecker winter sites on the plains differed from random sites (Fig. 5) ($\chi^2$ = 84.58, df = 7, $P < .001$). Wintering birds avoided plowed, grazed, and fallow fields. Lewis' Woodpeckers would flycatch in winter if the weather was warm enough to permit insect activity (Hadow 1973), and the absence of the birds near areas of bare ground, plowed fields and grazed fields may be related to low numbers of insects in these habitats. Corn fields comprised a major part of the surrounding winter habitat, probably because corn is the only storable mast available to Lewis' Woodpeckers on the plains.

This study demonstrates the importance of both occupied tree characteristics and the surrounding habitats in the site selection by this species. Lewis' Woodpeckers occurred primarily in riparian habitats in southeastern Colorado, and they relied heavily on large mature cottonwoods for both breeding and winter activities.

Lewis' Woodpeckers also inhabit open, park-like ponderosa pine forests during the breeding season (Bock 1970, Short 1982). However, I found little evidence of breeding activities in this habitat type. Their ab-

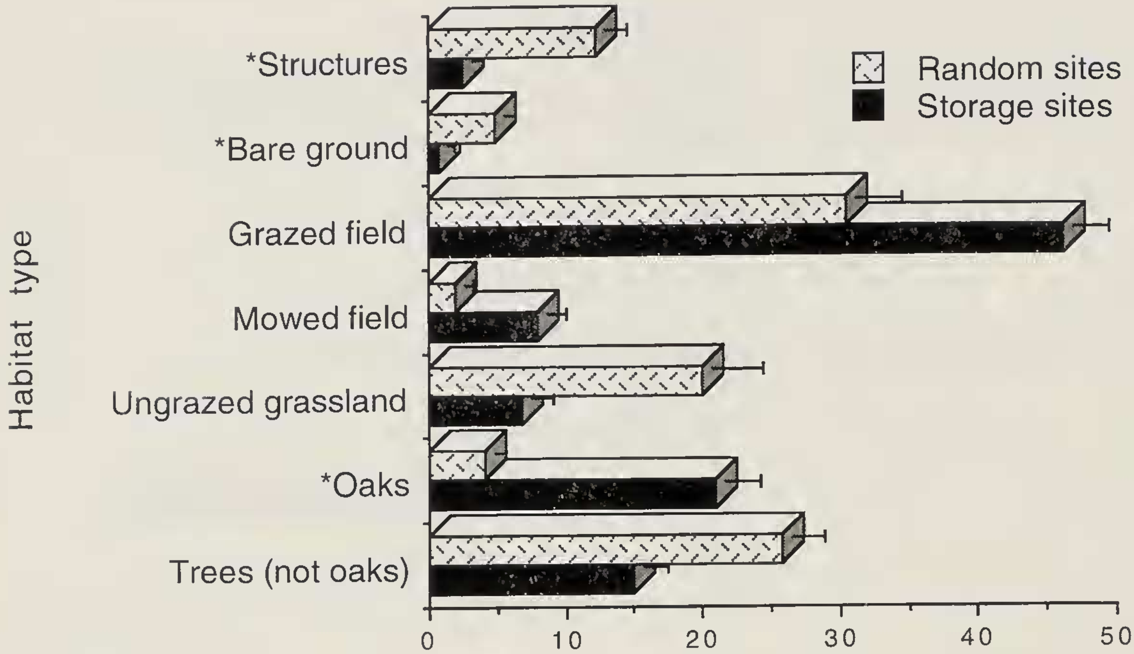


FIG. 4. Characteristics (mean percent habitat type per plot ± SD) of 100-m diameter plots surrounding 13 Lewis' Woodpecker storage trees vs 13 random trees during the 1992–1993 winter season in the foothills of the Wet Mountains. Asterisks represent those habitat variables which differ significantly between occupied and random sites.

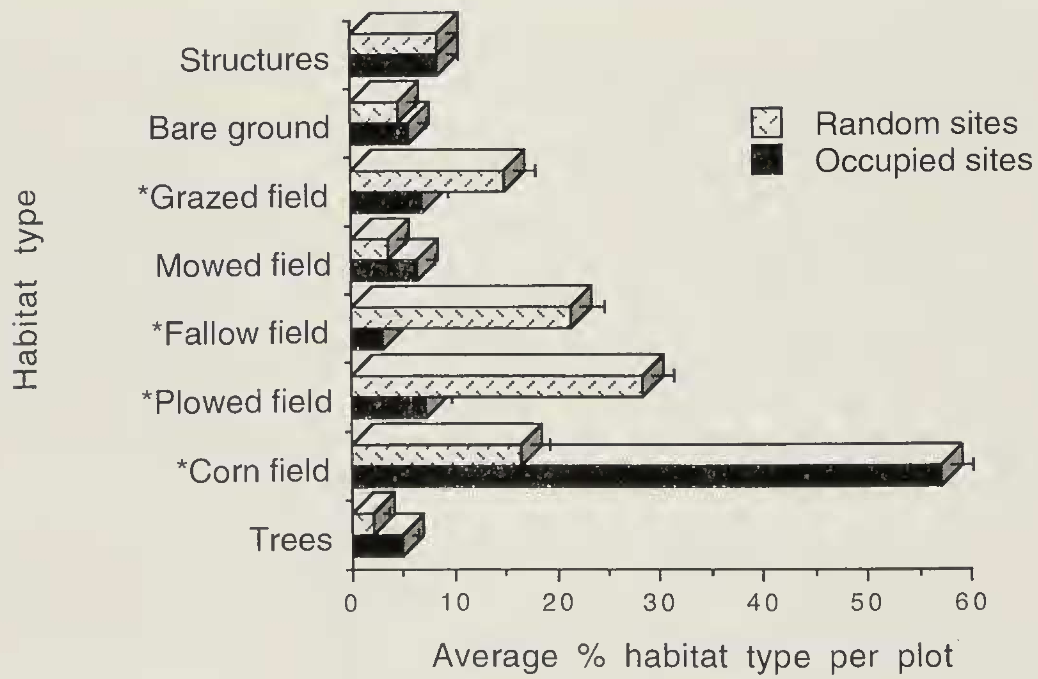


FIG. 5. Characteristics (mean percent habitat type per plot ± SD) of 100-m diameter plots surrounding 21 Lewis' Woodpecker storage trees vs 21 random trees during the 1992–1993 winter season on the plains of eastern Colorado. Asterisks represent those habitat variables which differ significantly between occupied and random sites.

sence in ponderosa pine forests may be related to the reduction of suitably open ponderosa pine forests in the region (Veblen and Lorenz 1991). These types of forests traditionally were maintained by fire and with the advent of fire suppression, ponderosa pine forests became denser (Veblen and Lorenz 1991, Covington and Moore 1994, Everett et al. 1994). Since Lewis' Woodpeckers require open areas in which to flycatch, the existing dense ponderosa pine forests in Colorado may be unsuitable for foraging purposes. Additional studies in different habitats are necessary in order to gain a comprehensive view of the habitat factors influencing site selection for breeding and wintering Lewis' Woodpeckers throughout their range.

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